13. Compliance Self-Monitoring

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Introduction

Unlike other parts of this report, which describe monitoring efforts that focus on potential impacts to the local community and environment, this chapter focuses on monitoring of discharges specifically called out in regulatory requirements. LLNL samples specific waste streams as required by regulatory permits as well as site influent and effluent waste streams. The monitoring methods range from sampling a specific process waste stream at the point of discharge to visual inspection of operational conditions of the waste stream. The type of monitoring that is conducted depends on the waste stream and the applicable regulatory requirements.

LLNL implements process controls to prevent the release of significant quantities of pollutants and to minimize waste. Because of these controls, the volume of the waste streams and potential impacts are usually modest compared to commercial or industrial standards.

Discharges of Treated Ground Water

Past hazardous materials handling and disposal practices, and leaks and spills that have occurred at the Livermore site and Site 300 both prior to and during LLNL operations have resulted in contaminants in ground water. The Environmental Restoration Division (ERD) at LLNL addresses Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) compliance issues. It also assesses the impact of releases on the environment and determines the restoration activities needed to reduce contamination concentrations to protect human health and the environment. Restoration activities include soil removal, ground water treatment, and closure of inactive facilities in a manner designed to prevent further environmental contamination.

The Environmental Protection Department operates five treatment facilities (TFA, TFB, TFC, TFD, and TFF) for CERCLA cleanup of ground water at the Livermore site. Self-monitoring is required at the point of discharge from each treatment facility to verify performance and effectiveness. Additional detail on specific treatment processes is contained in both the *LLNL Ground Water Project 1994 Annual Report* (Hoffman et al. 1994) and the *LLNL Site 300 Ground Water Monitoring Program Quarterly Reports* (Christofferson 1994a, 1994b, 1994c, 1995a). The self-monitoring activities and compliance sampling results which LLNL performs specifically for compliance with environmental discharge parameters are described below.

Treatment Facility A

Treatment Facility A (TFA) is located in the southwestern part of LLNL near Vasco Road **(**see **Figure 2-1** in Chapter 2). TFA treats ground water containing volatile organic compounds (VOCs) using a combination of ultraviolet light/hydrogen peroxide (UV/H_2O_2) treatment and air-stripping technologies. Pumping was halted during April and May 1994 to perform various well testing and maintenance tasks.

In September, following modification of the pipeline that connects extraction wells south of TFA, LLNL began processing ground water from three additional extraction wells. During the third quarter of 1994, construction of the Arroyo Seco Pipeline was completed. In October 1994, we began continuously pumping two additional wells. Flow rates from these two wells averaged about 189 liters per minute during the fourth quarter of 1994. In December, TFA also began pumping ground water from five additional extraction wells south of TFA. By the end of 1994, the combined flow from all extraction wells connected to TFA was 662 liters per minute.

During 1994, more than 87 million liters of ground water containing VOCs was processed at TFA. All treated ground water was discharged to the recharge basin, located about 610 meters southeast of TFA. Based on monthly influent concentrations and flow data, the total VOC mass removed during 1994 was about 5.6 kilograms. Since system startup in 1989, TFA has processed nearly 371 million liters of ground water and removed about 46 kilograms of VOC mass from the subsurface.

Waste Discharge Requirement (WDR) No. 88-075 requires a monthly sampling program for this facility (**Table 13-1**). Self-monitoring analytical results of TFA effluent samples indicate that the VOC discharge limit of 5 parts per billion (ppb) was not exceeded during 1994, except in the November 16 sample which totaled 5.8 ppb.

Treatment Facility B

Treatment Facility B (TFB) is located along Vasco Road just north of Mesquite Way. Similar to TFA, TFB processes ground water contaminated with chromium and VOCs using a combination of UV/H_2O_2 treatment and air technologies. In 1994, we increased the amount of H_2O_2 added to the UV chamber to chemically reduce hexavalent chromium to trivalent chromium, thereby lowering the effluent hexavalent chromium concentrations below the regulatory discharge limit of 10 ppb. However, the higher concentration of H_2O_2 in the effluent water

Table 13-1. Treated ground water discharge limits identified in WDR Order No. 88-075 for TFA.

Constituent	Discharge Limit (a)	Units
Metals		
Antimony	1.46	mg/L
Arsenic	500	µg/L
Beryllium	0.68	µg/L
Boron	7	mg/L
Cadmium	100	µg/L
Chromium (+ III)	1700	mg/L
Chromium (+ VI)	500	µg/L
Copper	2	mg/L
Iron	3	mg/L
Lead	500	µg/L
Manganese	500	µg/L
Mercury	20	µg/L
Nickel	134	µg/L
Selenium	100	µg/L
Silver	500	µg/L
Thallium	130	µg/L
Zinc	20	mg/L
Volatile organic compounds		
Total volatile organic compounds	5	µg/L
Acid extractable organic compounds		
2,4-Dimethylphenol	400	µg/L
Phenol	5	µg/L
2,4,6-Trichlorophenol	5	µg/L
Base/neutral extractable organic compounds		
1,4-Dichlorobenzene	5	µg/L
Naphthalene	620	µg/L
Phenanthrene	5	µg/L
Pyrene	5	µg/L

[a] These limits are instantaneous maximum values.

apparently resulted in lower than allowable fish bioassay survival rates. In November 1994, a filter bed containing 680 kilograms of granular activated carbon was installed downstream of the UV chamber. Tests results of bioassay samples collected on November 30 and December 7, 1994, indicated that H_2O_2 concentrations decreased, and the fish survival rates rose to 100%.

During 1994, about 32 million liters of ground water was treated at TFB. The average combined total flow rate from these wells was about 83 liters per minute. In 1994, all the ground water treated at TFB was discharged to the north-flowing drainage ditch along Vasco Road.

The total VOC mass removed during 1994 was about 2.7 kilograms. Since system startup in 1991, TFB has processed more than 87 million liters of ground water and removed about 9 kilograms of VOC mass from the subsurface.

National Pollutant Discharge Elimination System (NPDES) Permit No. CA0029289 and WDR No. 91-091 governs the operation of TFB and imposes monthly grab sampling requirements (**Table 13-2**). Self-monitoring analytical results of TFB effluent samples indicate that the VOC discharge limit, which is 5 ppb, was not exceeded. Metals concentrations were all in compliance with discharge limits, except one sample on December 20, which recorded hexavalent chromium at 12 ppb.

Treatment Facility C

Treatment Facility C (TFC) is located in the northwest quadrant of LLNL and employs air-stripping and ion-exchange technologies to process ground water contaminated with VOCs containing chromium. In 1994, TFC processed about 10 million liters of ground water containing about 1.2 kilograms of VOCs. Since system startup in October 1993, about 10.6 million liters of ground water containing 1.2 kilograms of VOC mass have been removed from the subsurface.

Before July 8, 1994, ground water treated at TFC was discharged to a north-flowing drainage ditch near TFC. In July 1994, a pipeline was installed in the ditch to convey treated water from TFC north to Arroyo Las Positas and prevent infiltration of treated water into underlying ground water that may contain VOCs, potentially spreading and/or diluting the plume.

In compliance with WDR No. 91-091 requirements, LLNL conducted monthly samplings at TFC. The monthly self-monitoring analytical results of TFC effluent samples indicate that the VOC discharge limit of 5 ppb was not exceeded during 1994, except for two samples. Methylene chloride was in the detected parameters; one in January reported 43 ppb, and the other in April reported 25 ppb. These detections are believed to be the result of analytical laboratory contamination. These results and the detailed explanations of them were reported in the *Progress Report to Remedial Project Managers, May 1994* (U.S. Department of Energy 1994).

Table 13-2. Treated ground water and Drainage Retention Basin discharge limits identified in WDR Order No. 91-091 for outfalls at locations CDBX, TFB, TFC, and TFD.[a]

Parameter	Discharge Limit[b]
Metals (μg/L)	
Antimony	1460
Arsenic	20
Beryllium	0.7
Boron	7000
Cadmium	5
Chromium (total)	50
Chromium (hexavalent)	11
Copper	20
Iron	3000
Lead	5.6
Manganese	500
Mercury	1
Nickel	7.1
Selenium	100
Silver	2.3
Thallium	130
Zinc	58
Organics (μg/L)	
Volatile organic compounds (total)	5
Benzene	0.7
Tetrachloroethene	4
Vinyl chloride	2
1,2 Dibromoethane	0.02
Total petroleum hydrocarbons	50
Polynuclear aromatic hydrocarbons	15
Base/neutral and acid extractable compounds and pesticides	5
Physical	
pH (units)	6.5–8.5
Toxicity	
Aquatic survival bioassay (96 hours)	90% survival median, 90 percentile value of not less than 70% survival

a Monitoring occurs at first discharge from the Drainage Retention Basin and at two additional discharges associated with storm water runoff monitoring. Toxicity is tested using the aquatic survival bioassay occurs once a year.

b Discharge limits do not apply to samples collected at the storm water runoff location WPDC.

Treatment Facility D

Treatment Facility D (TFD) is located in the northeast quadrant of LLNL and uses air-stripping and ion-exchange technologies to process contaminated ground water. Construction of TFD began on February 28, 1994, and was completed on July 13, 1994. TFD began operation on September 15, 1994, with one extraction well. The treated water discharge to the Drainage Retention Basin (DRB) began on September 29, 1994, ahead of schedule.

Two extraction wells were added in October. In November 1994, LLNL discontinued pumping from one well because the extracted ground water contained nickel in concentrations slightly above the TFD discharge limit of 7 ppb in WDR No. 91-091. No other metal parameters exceeded compliance requirements during 1994.

Once treatment for nickel is in place, we plan to resume ground water extraction from this well and begin discharging treated ground water directly to Arroyo Las Positas via an underground drainage pipeline. The average total flow rate from the two extraction wells is about 38 liters per minute.

During 1994, we processed about 0.3 million liters of ground water removing an estimated 0.3 kilograms of VOC mass. All treated water was discharged to the DRB. LLNL conducted monthly samplings at TFD in accordance with WDR No. 91-091 requirements. The monthly self-monitoring analytical results of TFD effluent samples indicated VOC compliance during 1994.

Treatment Facility F

Treatment Facility F (TFF) is located in a gasoline-contaminated area from an old gas station tank leak. It is used as a research site in support of the DOE-sponsored Dynamic Stripping Research Project (which is located next to Building 403) for soil and ground water remediation. The discharge of ground water remediated at TFF to the sanitary sewer (which in 1994 amounted to 15.4 million liters) is governed by the provisions of the Livermore Water Reclamation Plant (LWRP) Permit No. 1508G (1994–1995) for LLNL. The total liquid-equivalent of gasoline removed from the TFF subsurface during 1994 was about 300 liters. The sampling requirements for TFF discharges are quarterly sampling for benzene, ethyl benzene, toluene, and xylene (BETX; EPA Method 624) and annual sampling for total toxic organic compounds (EPA Methods 624 and 625), metals, and inorganic compounds.

Table 13-3 shows the BETX sampling results; no result was above the detection limit. Annual sample results for total toxic organics, sampled on August 9, 1994, showed no detections for all reportable organic compounds (detection limit is 0.01 mg/L). Two compounds not regulated under the total toxic organic compound standard were detected: acetone at 0.077 mg/L, and 1,1,2-trichloro-1,2,2-trifluoroethane at 0.025 mg/L. These values for the nonregulated

Table 13-3. Treatment Facility F self-monitoring sampling results.

Parameter	Sample Date (1994)	Concentration (mg/L)	Effluent Limitations[a] (mg/L)
BETX (total)	March 23	<0.01	0.25 (LWRP permit)
	June 9	<0.01	
	August 9	<0.01	
	October 27	<0.01	
Metals[a]	August 9		
Arsenic		<0.002	0.06
Cadmium		<0.0005	0.14
Copper		<0.010	1.00
Chromium (total)		<0.010	0.62
Lead		<0.0020	0.20
Mercury		0.0015	0.01
Nickel		<0.0050	0.61
Silver		<0.0005	0.20
Zinc		<0.020	3.00
Cyanide	August 9	<0.02	0.04
Toxic organics (total)	August 9	<0.01	1.00

[a] From Section 13.32.100 of the Livermore Municipal Code.

compounds are well below the LWRP permit limit of 1.0 mg/L for total toxic organic compounds.

Annual metals sample results for NPDES metals (EPA Method 200) are shown in **Table 13-3**. No results were found above discharge limits. Annual total cyanide sample results (EPA Method 335.2) for the year, sampled on August 9, 1994, showed no detections at the reporting limit of 0.020 mg/L. The LWRP permit limit for cyanide is 0.040 mg/L.

Sitewide Treatability Testing

LLNL's ground water discharge permit allows ground water from hydraulic tests and VOC treatability studies to be discharged to the City of Livermore sanitary sewer. Permit No. 1510G (1994–1995) allows discharges of ground water to the sanitary sewer in compliance with **Table 13-3** effluent limitations taken from the Livermore municipal code. During 1994, discharges were primarily from the startup of TFD. Nine separate discharges of well development water were sampled and released to the sanitary sewer, all in compliance with metals, total toxic organic, and self-monitoring permit provisions.

Total ground water discharged to the sanitary sewer during this annual period was 213,000 liters.

Site 300 Central and Eastern General Services Area Treatment Facilities

Since 1993, a ground water treatment system has been in operation at the LLNL Experimental Test Site, Site 300, in the central General Services Area (GSA) in the vicinity of Building 875 as an interim CERCLA Removal Action. Following dewatering of bedrock in July 1994 through ground water extraction, the operation of a soil vapor extraction and treatment system was initiated. During 1994, 0.5 million liters of ground water were extracted and treated, and a total of 7,725 grams of VOCs removed from ground water and soil vapor by the central GSA system. Monthly sample self-monitoring requirements are listed in **Table 13-4**.

Since June 1991, a ground water extraction and treatment system has been operating in the eastern GSA as part of an interim CERCLA Removal Action. During 1994, 82 million liters of ground water containing 742 grams of VOCs were extracted and treated by the eastern GSA system.

Table 13-4. General Services Area ground water treatment system effluent limitations.

Parameter	Treatment Facility	
	Central General Services Area	**Eastern General Services Area**
VOCs	Halogenated and aromatic VOCs	Halogenated VOCs
Maximum daily	5.0 µg/L	5.0 µg/L
Monthly median	0.5 µg/L	0.5 µg/L
Dissolved oxygen	≥5.0 mg/L	≥5.0 mg/L
pH	Between 6.5 and 8.5, no receiving water alteration greater than ±0.5 units	Between 6.5 and 8.5, no receiving water alteration greater than ±0.5 units
Temperature	No alteration of ambient conditions more than 3°C	No alteration of ambient conditions more than 3°C
Place of discharge	Corral Hollow Creek	Surface water drainage course in eastern GSA canyon
Flow rate (30-day average daily dry weather maximum discharge limit)	328,320 L (86,400 gal)	273,600 L (72,000 gal)
Mineralization	Mineralization must be controlled to no more than a reasonable increment	Mineralization must be controlled to no more than a reasonable increment
Methods and detection limits for VOCs	EPA Method 601—method detection limit of 0.5 µg/L	EPA Method 601—method detection limit of 0.5 µg/L EPA Method 602—method detection limit of 0.3 µg/L

The central GSA is operating under substantive requirements for wastewater discharge issued by the Central Valley Regional Water Quality Control Board (RWQCB). The central GSA treatment facility discharges to bedrock in the eastern GSA canyon, where the water percolates to the surface. The eastern GSA operates under NPDES permit No. 91-052, and discharges into Corral Hollow Creek. Both the central and eastern GSA treatment systems operated in-compliance with regulatory requirements during 1994.

Site 300 Building 834 Treatment Facility

Significant modifications to the ground water and soil vapor extraction and treatment facility at Building 834 were performed during 1994. These activities were performed in accordance with Site 300 CERCLA Removal Action requirements. This facility was designed to treat VOCs extracted from soil and ground water by air sparging and carbon absorption. Additional modifications to the facility were identified as a result of a spring 1994 test. Influent ground water concentrations ranged from 60 to 100 parts per million (ppm) total VOCs. Despite a substantial increase in the aggressiveness of sparging and recirculation, trichloroethene (TCE) permeated into polymeric components during the initial phase of water treatment. After the sparging process stopped, TCE slowly diffused back into the water as the concentration gradient shifted and greatly slowed the removal of VOCs.

All plastic components were eliminated from the influent side of the treatment facility. Numerous components were salvaged from LLNL Salvage and dismantled equipment from Building 834. The facility also incorporates additional liquid phase carbon filtration following the two sparging stages to ensure complete removal of tetra-butylorthosilicate (T-BOS) also present in substantial amounts (50–100 ppm) in influent ground water. Once ground water is treated to permit standards, it will be discharged by air-misting towers located east of the treatment facility.

The modified facility was successfully tested in February 1995. Additional equipment will be installed in fiscal year 1996 to support automated operation, continuous gas-phase monitoring, and remote inspection of facility status. The treatment facility was constructed with modularity in mind so that experimental treatment apparatus can be readily incorporated for direct comparison with the baseline sparging/carbon filtration approach.

During 1994, while modifications were being made, no ground water was treated or discharged from this facility. Once the facility receives final regulatory permits, continuous ground water treatment will begin. Final operating permits granted by the Central Valley RWQCB are expected to be issued in 1995. **Table 13-5** lists the CERCLA substantive requirements for this removal action.

Table 13-5. Site 300 Building 834 ground water treatment effluent limitations.

Parameter	Building 834 Treatment Facility
VOCs[a]	
Maximum daily	5.0 µg/L
Monthly median	0.5 µg/L
pH	Between 6.5 and 8.5
Location discharge	Treated effluent will be discharged by air misting east of Building 834.
Total petroleum hydrocarbons	
Daily maximum contaminant level	100 µg/L
Monthly median	50 µg/L
Flow rate (30-day average daily dry weather maximum discharge limit)	2,000 gal
Mineralization	Mineralization must be controlled to no more than a reasonable increment
Methods and detection limits for VOCs, T-BOS and total petroleum hydrocarbons (TPH)	Method EPA 601/602, modified EPA Method 8015, discharge limit ≤0.5 µg/L[b]

a The sum of VOC concentrations in a single sample shall not exceed 5.0 µg/L.

b Detection limits for T-BOS are currently ~100 µg/L by a modified EPA 8015 procedure. Additional analytical method development is in process at the Environmental Restoration Division (ERD) Analytical Chemistry Laboratory. Confirmatory VOC identifications were sometimes required during treatment facility characterization, and EPA 624 analyses were requested in addition to the EPA 601/602 analyses.

Storm Water Runoff

Storm water contacts a large number of potential pollution sources and can disperse contaminants across broad areas. For this reason, comprehensive sampling and analysis of storm water discharges is not a practical means of isolating and controlling pollutant releases. To evaluate the overall impact of LLNL and Site 300 operations on storm water quality, samples are taken of the integrated storm water flows where they leave the site. These samples, described in Chapter 6, provide information used to evaluate the effectiveness of LLNL's pollution control program. The monitoring requirements in NPDES permits, under which storm water is discharged, require that LLNL conduct effluent sampling and inspect facilities to assure that the necessary management measures are being implemented. The goals of the industrial activity storm water monitoring program are to:

- Demonstrate compliance with permit requirements
- Aid in implementing the Storm Water Pollution Prevention Plan (SWPPP; Eccher 1994)
- Measure the effectiveness of the Best Management Practices (BMPs) in removing pollutants in storm water discharges

- Ensure that storm water discharges are in compliance with the discharge prohibitions, effluent limitations, and receiving water limitations as specified in the permits
- Ensure practices at the facility to control pollutants are evaluated and revised to meet changing conditions

The compliance monitoring program includes annual facility inspections as well as sampling and analysis of storm water from two qualifying storm events for pH, total suspended solids (TSS), total organic carbon (TOC), specific conductance, toxic substances, and other pollutants that are likely to be in storm water discharges in significant quantities. It also includes visual observations at storm water discharge points during the dry and wet seasons and annual reporting to the appropriate regional water quality control boards. In addition, LLNL's compliance monitoring includes analysis of samples collected at several influent locations to provide background information. The compliance storm water monitoring program data evaluation is discussed in detail in Chapter 6.

Under the California General Industrial Activity Storm Water Permit for the Livermore site and WDR Order No. 94-131 for Site 300, visual inspections of the storm drainage system are required monthly during the wet season when significant storm events occur, and twice during the dry season to identify any dry weather flows. During the wet weather observations, LLNL found floatables, evidence of debris (mostly leaf litter) washing from the site, and cloudy water from the heavy sediment load carried in the storm water. During the dry weather observations, three specific areas were discovered where ponding and growth of vegetation gave evidence of dry weather flow at the Livermore site. These areas are located in Arroyo Las Positas, they are believed to be associated with landscape irrigation overflows. In addition, dry weather flows were observed during the March through May time frame, periodically flowing in the northwest quadrant of the site. No source for those flows was identified. Dry weather inspections at Site 300 showed no indication of nonstorm water flows discharging from the site.

Each LLNL directorate inspected its facilities to verify that the BMPs identified in the LLNL's Storm Water Pollution Prevention Plans are in place, properly implemented, and adequate. LLNL implements BMPs at construction sites and at facilities that use significant materials (as defined by the storm water regulations) to prevent storm water from being contaminated. The results of the inspections indicated LLNL facilities were in compliance with the requirements of the SWPPPs and the provisions of the NPDES permits.

LLNL also complies with storm water compliance monitoring requirements that are authorized under the California General Construction Activity Storm Water Permit for construction projects disturbing 5 acres of land or more. Monitoring included visual observation of sites before and after storms to assess the effectiveness of implemented BMPs. Using the monitoring results, LLNL determined whether it was necessary to modify these practices to accomplish better storm water runoff protection. Two construction sites were inspected during 1994. These included the Site 300 Doall Road Project and the construction of Building 132 at the Livermore site. LLNL made no changes to the BMPs implemented at each of these large construction sites. However, minor changes were made to smaller projects located in environmentally sensitive areas. These changes included the addition of staked hay bales to minimize sediment in runoff and modification of material storage to prevent introducing these materials into storm water runoff.

Livermore Site Drainage Retention Basin

The Drainage Retention Basin (DRB; previously known as the Central Drainage Basin; **Figure 13-1**) was lined as part of the Livermore site remedial activities and has a capacity of approximately 53 million liters (43 acre-feet). Remedial action studies indicated that infiltration of storm water from the basin was a cause of increased dispersal of ground water contaminants. In March 1992, the basin lining was completed, and LLNL adopted the *Drainage Retention Basin Management Plan* (The Limnion Corporation 1991).

The focus of the management plan was to implement a long-term biological monitoring and maintenance program and to address water quality problems by reducing nutrient loading and bioremediation. Water quality management objectives are maintained by: (1) sediment removal in sediment basins located at the influent points to the DRB; (2) management of upstream watershed activities; (3) use of submersed plants and, in the shallow portions of the basin, rooted aquatic plants to remove urban runoff pollutants and control erosion of the basin lining cover; and (4) addition of oxygen by means of recirculating pumps. The management plan identified two water sources to fill and maintain the level of the DRB. The primary identified water source was water generated from ground water treatment units and discharged to the basin through the existing storm water collection system or piped directly to the DRB. The secondary water source is storm water runoff. During 1994, storm water runoff was the primary DRB water source; a small amount of treated wastewater was discharged from TFD from September through December.

The San Francisco Bay RWQCB regulates discharges from the basin under WDR Order No. 91-091, NPDES Permit No. CA0029289, and the Livermore site CERCLA Record of Decision. WDR Order No. 91-091 and the CERCLA Record of Decision establish discharge limits for all remedial activities at the Livermore site.

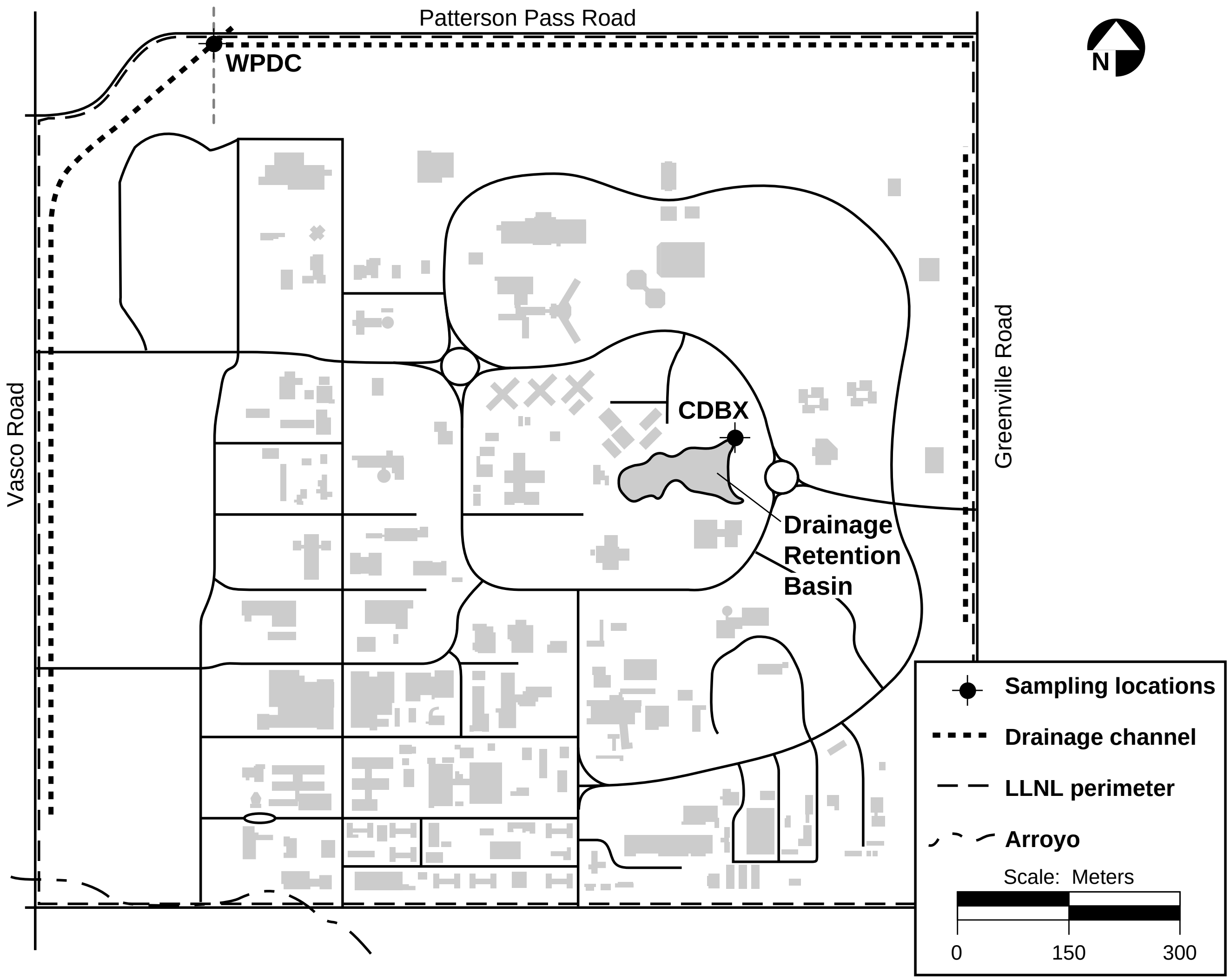

Figure 13-1. Sampling locations to monitor compliance with waste discharge permit.

Limits set for discharges from the DRB to the Livermore storm water collection system are found in **Table 13-2**. Exceeding any of these limits constitutes noncompliance with the NPDES permit and the CERCLA Record of Decision.

In 1992, LLNL developed a sampling program for the DRB, which was approved by the San Francisco Bay RWQCB. The sampling program consists of sampling discharges from the DRB (location CDBX) and the site storm water outfall (location WPDC; **Figure 13-1**) during the first release from the DRB and a minimum of one additional storm (chosen in conjunction with storm water runoff monitoring). In addition, LLNL agreed to conduct and report to the San Francisco Bay RWQCB routine weekly, monthly, quarterly, semiannual, and annual monitoring of the basin as specified in the *Drainage Retention Basin*

Management Plan (The Limnion Corporation 1991) for water quality management objectives. Water quality management objectives are found in **Table 13-6**; they are used as a tool to optimally operate the DRB. While operation outside these parameters does not constitute noncompliance with limits established in the NPDES permit and CERCLA Record of Decision, it indicates that an action should be taken to properly maintain water quality within the DRB.

Since September 1993, results of routine water quality monitoring for management parameters and discharge monitoring have been reported to regulatory agencies in the monthly, quarterly, and annual ground water project progress reports (Hoffman et al. 1994a, 1994b, 1994c). Sampling is performed to provide information necessary to establish compliance with WDR Order No. 91-091 and the Applicable, Relevant, and Appropriate Requirements (ARARs) identified in the CERCLA Record of Decision; to provide information necessary for DRB maintenance; and to document the effectiveness of nutrient removal.

Sampling to determine compliance with WDR Order No. 91-091 occurs at the DRB outfall (CDBX). Additional sampling at the site storm water outfall monitoring location at Arroyo Las Positas (WPDC) is done to identify the change in water quality as the DRB discharges travel through the LLNL storm water drainage system and leave the site. Only analytical data associated with a release from the DRB are discussed in this section. Analytical data from WDPC are discussed and presented completely in Chapter 6. Discharge monitoring parameters are identified in **Table 13-2**.

Sampling to determine whether water quality maintenance objectives are met is conducted at several points within the DRB. Sampling for dissolved oxygen and temperature occurs at eight locations identified in **Figure 13-2**. Sampling during the 1992–1993 wet season was also conducted at all these monitoring locations for all other monitoring parameters. However, because there was evidence of limited variability between sampling locations for all parameters except dissolved oxygen and temperature, all sampling locations except CDBE located at the middle depth of the DRB were eliminated starting March 31, 1993. The routine maintenance parameters are identified in **Table 13-6**.

During 1994, only lead and nickel exceeded NPDES discharge limits (**Table 13-7**). Nickel was seen for the first time in December 1993 and has continued to show up in samples collected from all DRB discharges during 1994. Nickel from the DRB is higher than the nickel found in storm water discharges at the site, but is not inconsistent with these discharges. Lead showed up for the first time in the November 15 release from the DRB. Lead was not detected in the subsequent December discharge sample. The source of the nickel and lead are unknown but believed to be associated with the storm water influent to the DRB. During 1994,

Table 13-6. Routine water quality management levels for the Drainage Retention Basin.

Parameter	Location	Frequency	Management Action Levels
Physical			
Dissolved oxygen (mg/L)	CDBA, CDBC, CDBD, CDBE, CDBF, CDFJ, CDBK, CDBL	Weekly	Not less than 5, 80% saturation
Temperature (°C)	CDBA, CDBC, CDBD, CDBE, CDBF, CDFJ, CDBK, CDBL	Weekly	<15 and >26
Total alkalinity (mg/L)	CDBE	Monthly	<50
Chlorophyll A (mg/L)	CDBE	Monthly	>10
pH (units)	CDBA, CDBC, CDBD, CDBE, CDBF, CDFJ, CDBK, CDBL	Weekly	<6.0 and >9.0
Total suspended solids (mg/L)	CDBE	Monthly	
Total dissolved solids (mg/L)	CDBE	Monthly	>350
Turbidity (meters)	CDBE	Monthly	<0.914
Chemical oxygen demand (mg/L)	CDBE	Quarterly	>20
Oil and grease (mg/L)	CDBE	Quarterly	>15
Conductivity (µmhos/cm)	CDBE	Monthly	>900
Nutrients			
Nitrate (mg/L)	CDBE	Monthly	>0.2
Nitrite (mg/L)	CDBE	Monthly	>0.2
Ammonia nitrogen (mg/L)	CDBE	Monthly	>0.1
Phosphate as phosphorous (mg/L)	CDBE	Monthly	>0.02
Microbiological			
Total coliform (MPN/0.1L)	CDBE	Quarterly	>5000
Fecal coliform (MPN/0.1L)	CDBE	Quarterly	>400
Metals (µg/L)			
Antimony	CDBE	Semiannually	>1460
Arsenic	CDBE	Semiannually	>20
Beryllium	CDBE	Semiannually	>0.7
Boron	CDBE	Semiannually	>7000
Cadmium	CDBE	Semiannually	>5
Chromium, total	CDBE	Semiannually	>50
Chromium, hexavalent	CDBE	Semiannually	>11
Copper	CDBE	Semiannually	>20
Iron	CDBE	Semiannually	>3000

Table 13-6. Routine water quality management levels for the Drainage Retention Basin (*concluded)*.

Parameter	Location	Frequency	Management Action Levels
Metals (μg/L) (continued)			
Lead	CDBE	Semiannually	>5.6
Manganese	CDBE	Semiannually	>500
Mercury	CDBE	Semiannually	>1
Nickel	CDBE	Semiannually	>7.1
Selenium	CDBE	Semiannually	>100
Silver	CDBE	Semiannually	>2.3
Thallium	CDBE	Semiannually	>130
Zinc	CDBE	Semiannually	>58
Organics (μg/L)			
Total volatile organic compounds	CDBE	Semiannually	>5
Benzene	CDBE	Semiannually	>0.7
Tetrachloroethene	CDBE	Semiannually	>4
Vinyl chloride	CDBE	Semiannually	>2
Ethylene dibromide	CDBE	Semiannually	>0.02
Total petroleum hydrocarbons	CDBE	Semiannually	>50
Polynuclear aromatic hydrocarbons	CDBE	Semiannually	>15
Base neutral/acid extractable compounds and pesticide	CDBE	Semiannually	>5
Radiological (pCi/L)			
Gross alpha	CDBE	Semiannually	>15
Gross beta	CDBE	Semiannually	>50
Tritium	CDBE	Semiannually	>20,000
Toxicity (%/96-hour survival)			
Fish bioassay	CDBE	Annually	90% survival median, 90 percentile value of not less than 70% survival

turbidity, nitrate, ammonia nitrogen, and phosphorous continued to be detected at levels exceeding acceptable management objectives and / or management action levels at sampling location CDBE (**Table 13-8**). In addition, chlorophyll a, lead, and nickel exceeding acceptable management levels were detected for the first time at sampling location CDBE. As discussed earlier, lead and nickel were also detected in excess of NPDES permit discharge limitations.

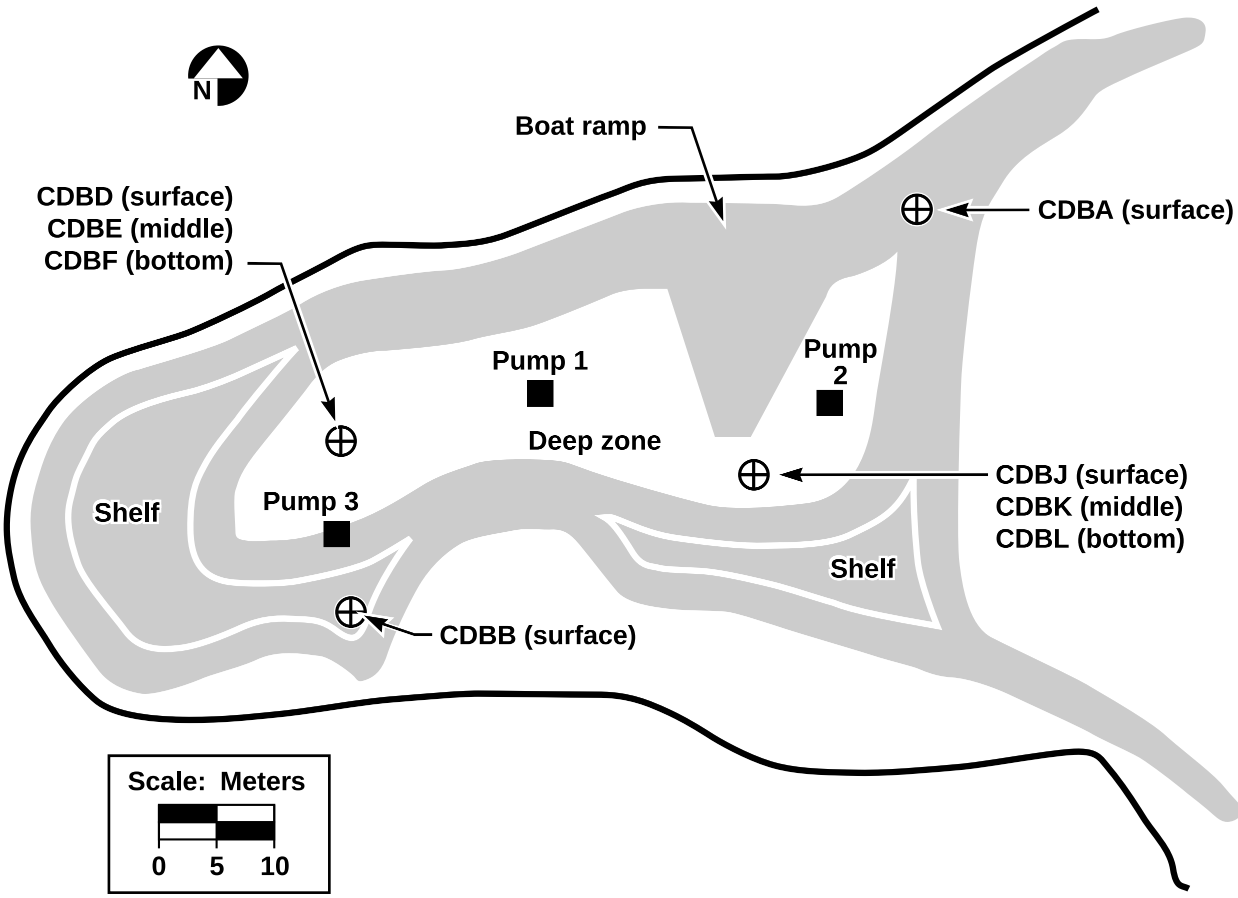

Figure 13-2. Sampling locations within Drainage Retention Basin to determine maintenance of water quality objectives.

Dissolved oxygen concentrations rarely were maintained at the management objective of at least 80% saturation of oxygen in the water (**Figure 13-3**).

However, concentrations did not drop below the critical management action level of 5 mg/L. Dissolved oxygen levels were controlled manually with aeration pumps. Permanent pumps were installed in March 1994. The aeration pumps are started whenever oxygen levels at any level of the DRB drop close to or below the management action level of 5 mg/L.

Pump operation probably is responsible for the relatively uniform distribution of dissolved oxygen at the surface, middle, and bottom elevations (**Figure 13-4**). Adequate dissolved oxygen levels prevents nutrient release back into the DRB water column by decaying organic matter in the bottom sediments. Temperature, which is the other parameter important in dissolved oxygen saturation in water, showed characteristic seasonal trends (**Figure 13-5**). The uniform

Table 13-7. Drainage Retention Basin monitoring events exceeding discharge limits at CDBX and associated water quality at WPDC, 1994.[(a)]

	Beryllium	Copper	Lead	Nickel	Zinc
Units	µg/L	µg/L	µg/L	µg/L	µg/L
Discharge Limit	0.7	20	2	7.1	58
CDBX					
Feb 7	<*x*			29	
Nov 15	<*x*		4.5	10	
Dec 14				9.5	
WPDC					
Feb 7				8.8	
Nov 15		34	10	40	160
Dec 14	1.4	33	19	44	200
Number of samples	3	3	3	3	3

a Blanks in the table are below the detection limit.

Table 13-8. Drainage Retention Basin monitoring events exceeding Management Action Levels, 1994.[(a)]

	Analyte							
	Nitrate	**Nitrite**	**Ammonia nitrogen**	**Phosphorus Total (as P)**	**Chlor-ophyll a**	**Turbidity (secchi disk)**	**Lead**	**Nickel**
Units	mg/L	mg/L	mg/L	mg/L	mg/L	Meters	µg/L	µg/L
Action level	>0.2	>0.2	>0.1	>0.2	>10	<.914	>2	>7.1
Jan 11						0.7		
Feb 9						0.7		
Mar 14	0.9	0.5	0.15	0.073				NS
Apr 15	5	<5						
May 13				0.056	12			
Jun 21			0.11					
Jul 21	<*y*							
Aug 17						0.75		
Sep 22	31			0.6	36	0.46		
Oct 10	20					0.61	2.7	12
Nov 9								8
Nov 11	16		0.18	0.5		0.61		
Dec 29	2.9		0.3			0.28		
Number of samples	12	12	12	11	12	10	3	2

a Blanks in the table are below the detection limit.

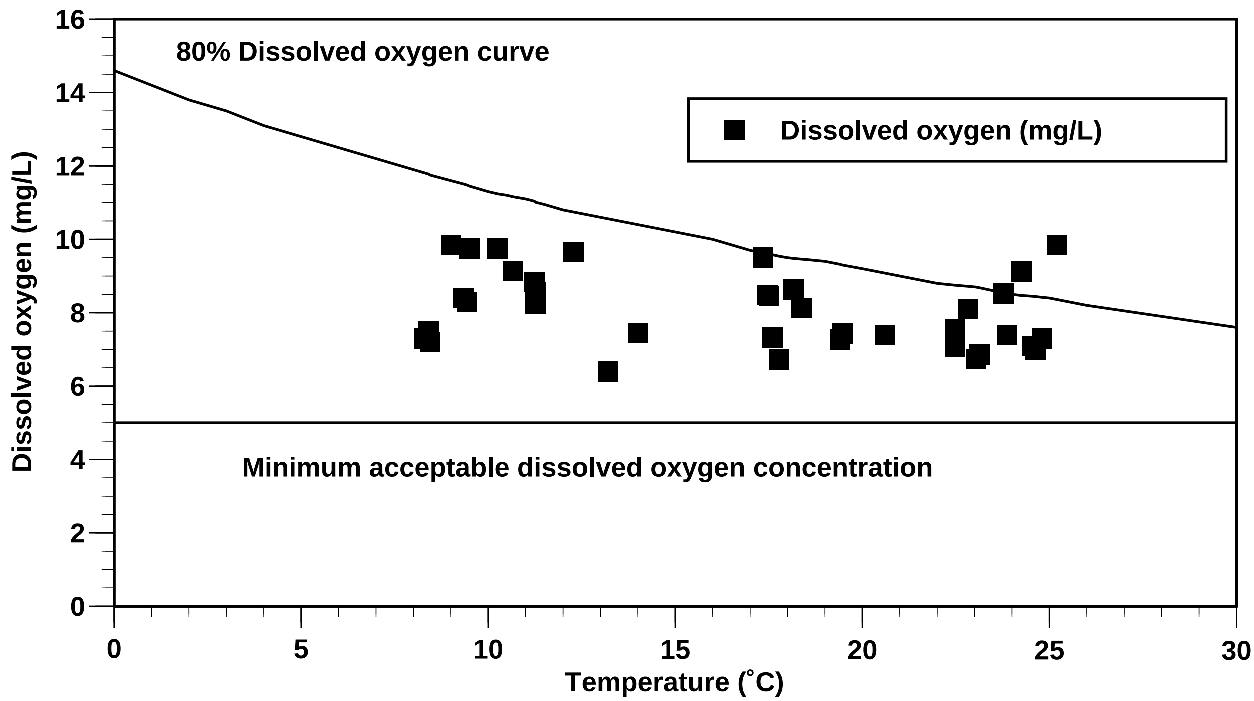

Figure 13-3. Dissolved oxygen vs temperature in the Drainage Retention Basin from January through December, 1994.

distribution of temperature in the top, middle, and bottom elevations also reflects the uniform mixing achieved by the manual operation of the pumps. Without mixing, the temperature would show seasonal stratification in addition to the changes in temperature.

Elevated turbidity above acceptable management levels occurred during the 1993–1994 and 1994–1995 wet seasons and is probably a result of sediments that were not captured by the sediment traps discharging into the DRB. The sediment traps were not cleaned after the 1992–1993 wet season and, therefore, may not have been functioning properly. Sediment was removed from the sediment basins in the fall of 1994 before the wet season to avoid similar turbidity problems. Turbidity seen during the warmer summer months is most likely the result of algae growth. This is confirmed by high chlorophyll a values during times of high turbidity.

Nutrient levels for nitrate/nitrites, total ammonia, and phosphate/phosphorous had higher than acceptable management levels for most of 1994. The nutrients introduced from storm water discharges are fecal matter from migrating water fowl, the mosquito fish population, and decaying organic matter. The plants

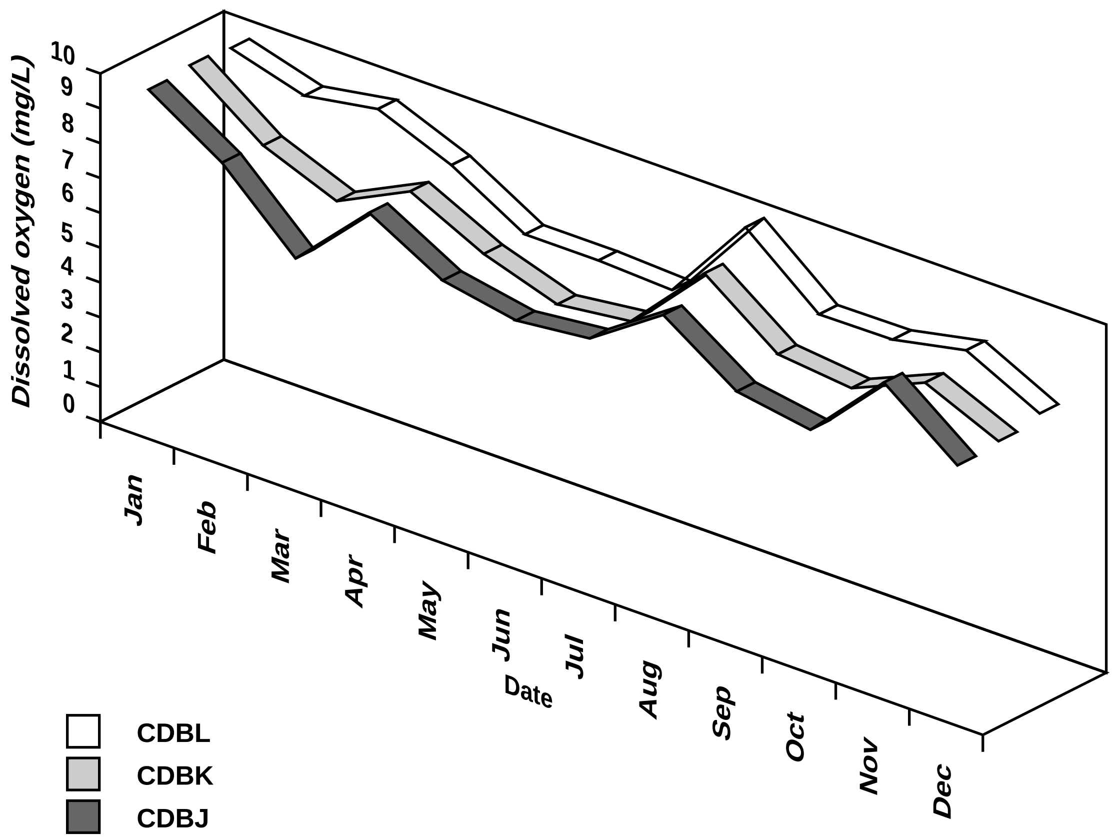

Figure 13-4. Dissolved oxygen vs time at three monitoring points within the Drainage Retention Basin, 1994.

introduced to the lake to reduce nutrient loading both within the Nutri-Pods (suspended nylon sacks that house the plants) and planted on the shallow shelves have not been successfully established. This is most likely the result of the chronic turbidity problem and some operational difficulties encountered with the Nutri-Pods. Until a healthy plant community is established in the DRB, high nutrient loadings and algae blooms are expected to continue.

A management contract was implemented with a landscaping company in December 1993 to assure that the plants contained in the Nutri-Pods are maintained within the proper photic zone to allow optimal growth. However, this effort has had marginal results. The beginning of the wet season, which flushes the lake with new storm water runoff flows, currently is the main mechanism operating to minimize nutrient levels.

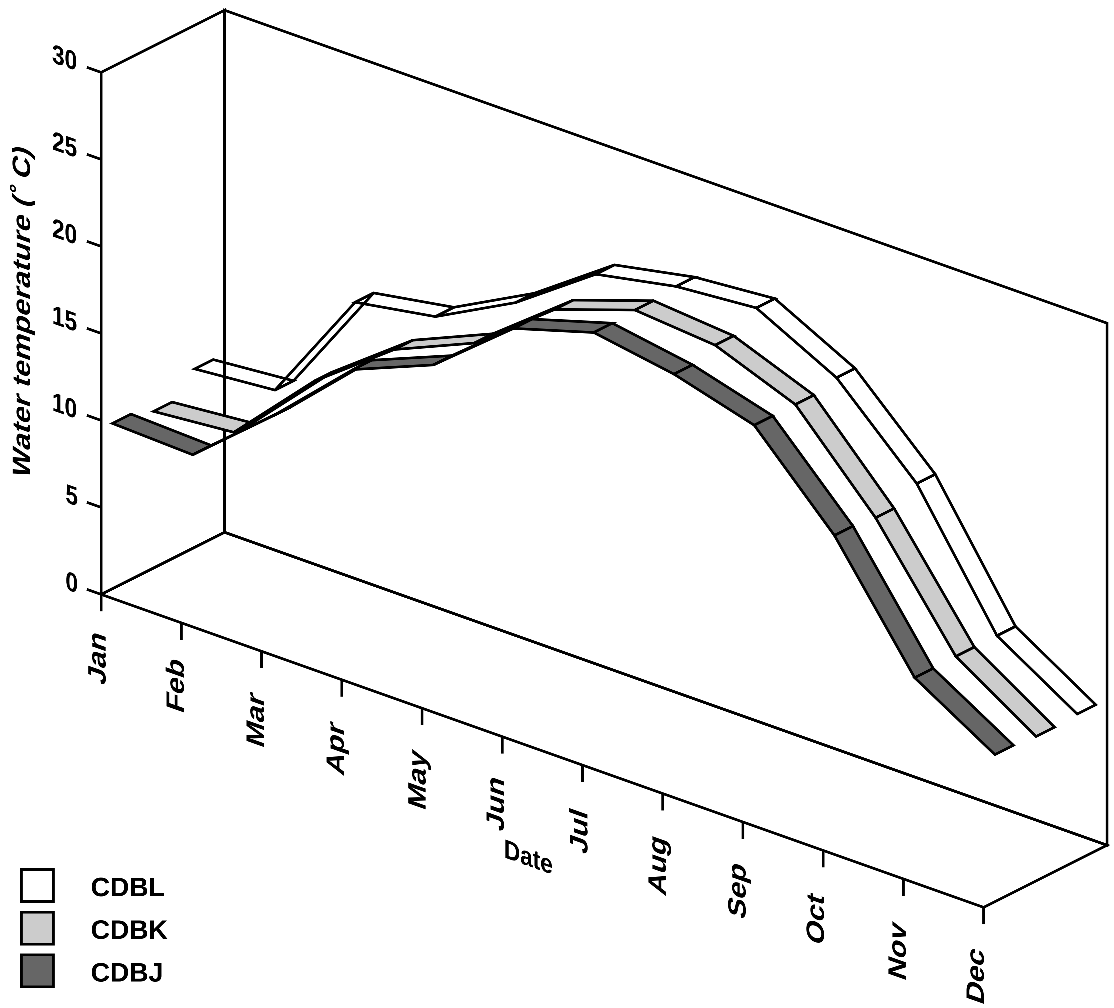

Figure 13-5. Temperature vs time at three monitoring points within the Drainage Retention Basin, 1994.

Lead was seen above acceptable management levels only once in third-quarter monitoring results during the semiannual sample collection. However, nickel, first detected in December 1993 in discharge samples, has persisted throughout 1994. The source of these elevated metals is unknown. The detection data for locations CDBX and CDBE and field measurements for CDBA through L are summarized in **Tables 13-9, 13-10,** and **13-11**; summary data for maintenance monitoring at sampling location CDBE are presented in Tables 13-1, 13-2, and 13-3 in Volume 2. Data from location WPDC is summarized in Chapter 6.

Table 13-9. CDBX data summary.

Parameter	Units	Minimum	Maximum	Median	Interquartile Range	Number of Samples
Metals						
Antimony	mg/L	0.0055	<0.06	0.0055	0.0275	3
Arsenic	mg/L	0.0035	0.0046	0.0038	0.00055	3
Boron	mg/L	0.11	0.14	0.12	0.015	3
Chromium	mg/L	0.0061	<0.01	0.01	0.00195	3
Copper	mg/L	0.0067	<0.01	0.0097	0.00165	3
Lead	mg/L	<0.002	0.0045	0.002	0	3
Nickel	mg/L	0.0095	0.029	0.01	0.00975	3
Zinc	mg/L	0.029	0.034	0.0315	0.0025	2
Toxicity						
Aquatic bioassay, survival	Percent	90				1
Organics						
EPA 504						
Ethylene dibromide	µg/L	<0.01	<0.1	<0.02	0.045	3
General Minerals						
Bicarbonate alkalinity (as $CaCO_3$)	mg/L	70	74	71	2	3
Calcium	mg/L	21	23	21	0	3
Chloride	mg/L	7.8	14	8.7	3.1	3
Fluoride	mg/L	0.089	0.13	0.12	0.0205	3
Magnesium	mg/L	5.4	6.2	5.6	0.4	3
Nitrate (as N)	mg/L	<0.5	0.59	<0.5	0	3
pH	Units	7.3	8.3	7.7	0.5	3
Potassium	mg/L	3.6	4.1	3.6	0	3
Sodium	mg/L	8.7	11	11	1.15	3
Specific conductance	µmho/cm	180	190	180	0	3
Sulfate	mg/L	4.8	18	6.3	6.6	3
Total alkalinity (as $CaCO_3$)	mg/L	70	74	71	2	3
Total dissolved solids (TDS)	mg/L	110	120	110	0	3
Total hardness (as $CaCO_3$)	mg/L	75	83	75	0	3
Total suspended solids (TSS)	mg/L	4	29	20	12.5	3
Total organic carbon (TOC)	mg/L	6.6	8	7.4	0.7	3
Chemical oxygen demand	mg/L	21	34	27.5	6.5	2
Radiological						
Gross alpha	pCi/L	0.81	0.95	0.92	0.07	3
Gross beta	pCi/L	2.99	8.75	3.68	2.88	3
Tritium	pCi/L	444	662	542	109	3

Table 13-10. Data summary of maintenance monitoring at sampling location CDBE.

Parameter	Units	Minimum	Maximum	Median	Interquartile Range	Number of Samples
Field Measurements						
Dissolved oxygen	mg/L	6	10	8	2	37
Temperature	˚C	8	25	19	8	38
Turbidity	Meters	0.28	3.66	0.61	1.397	15
Chlorophyll a	µg/L	<0.5	36	12	20.2	11
General Minerals						
Bicarbonate alkalinity (as $CaCO_3$)	mg/L	62	230	76	16.5	11
Calcium	mg/L	18	25	20	3	11
Carbonate alkalinity (as $CaCO_3$)	mg/L	1	1	1	0	11
Chloride	mg/L	5.2	27	6.7	2.05	11
Copper	mg/L	0.05	0.05	0.05	0	11
Fluoride	mg/L	0.087	0.13	0.1	0.0135	11
Magnesium	mg/L	4.7	6.6	5.5	0.8	11
pH	Units	6.5	9	7.8	0.75	11
Potassium	mg/L	2.8	4.5	3.7	0.5	11
Sodium	mg/L	7.8	11	9.1	1.45	11
Specific conductance	µmho/cm	130	210	150	45	11
Sulfate	mg/L	4	19	5.6	1.55	11
Surfactant	mg/L	<0.5	<0.5	<0.5	0	11
Total alkalinity (as $CaCO_3$)	mg/L	62	230	76	16.5	11
Total dissolved solids (TDS)	mg/L	63	160	110	26.5	11
Total hardness (as $CaCO_3$)	mg/L	64	87	74	11.5	11
Total suspended solids (TSS)	mg/L	1	26	9	9	9
Chemical Oxygen Demand	mg/L	18	110	26	26	4
Biological						
Fecal coliform	MPN/100mL	2	4	2	1	4
Total coliform	MPN/100mL	8	500	158.5	335.25	4
Metals						
Arsenic	mg/L	0.0034	0.0043	0.0037	0.00045	3
Copper	mg/L	0.0079	0.012	<0.01	0.00205	3
Iron	mg/L	1.2	1.6	1.4	0.2	2
Manganese	mg/L	0.034	0.057	0.0455	0.0115	2
Nickel	mg/L	0.008	0.012	0.01	0.002	2
Total Organic Carbon (TOC)	mg/L	6	8	7	1	2
Toxicity						
Aquatic bioassay, survival	Percent	100	100	100	0	1

Table 13-11. Drainage Retention Basin maintenance field measurement monitoring summary for all stations except CDBE.

Parameter	CDBA	CDBC	CDBD	CDBF	CDBJ	CDBL
Dissolved oxygen (mg/L)						
Minimum	7	5	6	4	6	3
Maximum	13	12	11	10	11	11
Median	9	9	8	8	8	8
Interquartrile range	2	2	2	2	2	1
Number of samples	37	37	37	37	37	37
Temperature (°C)						
Minimum	8	8	8	8	8	8
Maximum	28	26	26	25	26	26
Median	22	21	20	19	21	20
Interquartile range	7	7	7	8	7	7
Number of samples	38	38	38	38	38	38

Site 300 Cooling Tower Discharges

LLNL samples cooling tower wastewater discharges as required by the Self-Monitoring Program of NPDES permit CA0081396. On May 20, 1994, the Central Valley RWQCB renewed this permit by Board Order 94-131. Revised monitoring requirements incorporated into the renewed permit were implemented in June 1994 by agreement with the Central Valley RWQCB. The new order also permitted storm water discharges as discussed earlier in this chapter, and monitoring data is presented in Chapter 6. LLNL continues to report self-monitoring results of cooling tower discharges to the Central Valley RWQCB quarterly.

The cooling towers, used to cool buildings and equipment at Site 300, discharge noncontact cooling water to man-made and natural drainage courses (**Figure 13-6**). These drainage courses flow into Corral Hollow Creek, a tributary to the San Joaquin River. Because the San Joaquin River is a United States water, all discharges to it and its tributaries require NPDES permits.

LLNL eliminated surface water discharges from 14 of the 17 cooling towers by engineering the wastewater discharges to ground through percolation pits. Towers engineered to percolation pits include Buildings 805, 809, 810, 812, 815, 817, 826, 827-1, 827-2, 828, 836D, 851-1, 851-2, and 854. Towers that will continue regular discharges to surface water drainage courses are Buildings 801, 836A, and 865. The Central Valley RWQCB waived the need for WDRs for discharges to the percolation pits because the discharges posed no threat to the receiving water body (ground water) if the pits were constructed and operated as designed. Construction and rerouting of the discharges began in September 1994

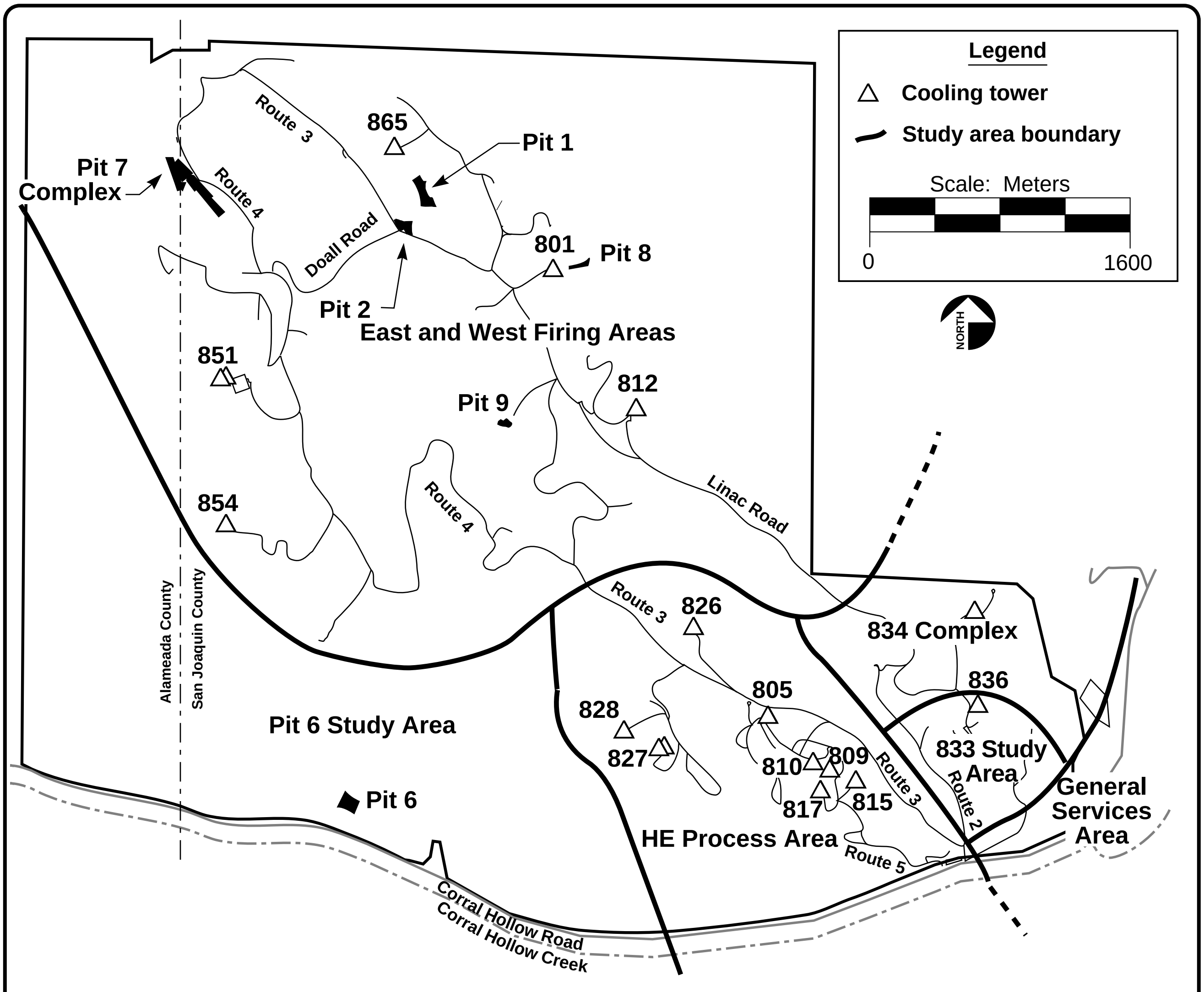

Figure 13-6. Site 300 cooling tower locations, 1994.

and was completed by the compliance schedule deadline, December 1994. WDR Order No. 94-131 established limitations for these 14 towers for the interim period when the percolation pits were under construction and for periods when it may be necessary to temporarily switch discharges back to surface water drainage courses, such as during maintenance of the percolation pits.

For the January through May period, LLNL monitored pH, temperature, and discharge flow. Specific limitations imposed for this period included: (1) daily flow must not exceed maximum design flow, (2) temperature must not alter the ambient receiving water temperature by more than 2.8°C (5°F), and (3) pH must be within the range of 6.5 to 8.5 pH units.

The revised monitoring program under WDR Order No. 94-131 continued the maximum flow requirement, eliminated the temperature requirement, granted the requested expanded pH range, and added total dissolved solids (TDS) limitations. The maximum pH for surface water discharges from all of the cooling towers was expanded from 8.5 to 10.0.

The new permit established daily maximum and monthly average TDS limitations for the three towers continuing to regularly discharge to surface water drainage courses. Separate limits were established for the other 14 towers for the temporary periods of discharge to surface water drainage courses. Regular discharges from Buildings 801, 836A, and 865 cannot exceed a monthly average of 2000 mg/L nor a maximum daily limitation of 2,400 mg/L. TDS concentrations for the other 14 towers during periods of surface water discharge cannot exceed a monthly average of 2,000 mg/L nor a daily maximum of 5,000 mg/L.

pH

For the period of January through May, cooling tower discharges routinely exceeded the maximum pH limitation of 8.5. The noncomplying levels occurred during normal operations. The source of cooling tower supply water is on-site drinking water wells, which routinely has a pH of 8.1 to 8.7. The addition of corrosion-inhibiting chemicals further raises the pH. The Central Valley RWQCB concurred with LLNL's argument that no negative impact to the receiving water results from these discharges and raised the pH limitation to 10.0. All discharges were in compliance with the pH limitation after May 1994.

Temperature

Temperature was only reported from the period of January through May because it was not a required monitoring parameter under the renewed permit. LLNL did not note any noncompliance with this requirement.

Flow

The cooling towers routinely operate below the permitted flow requirement. Occasional excursions are noted in monitoring reports. These excursions more likely result from over estimating the flow rate than actually exceeding the design flow capacity of a tower. LLNL does not use automatic flow monitors on the cooling tower. LLNL technicians estimate total flow from 5-minute interval measurements. Cooling towers discharge wastewater intermittently rather than continuously as this estimation technique assumes.

TDS

All valid samples collected show cooling tower discharges are in compliance with the TDS daily maximum and monthly average limits. Two sample sets collected at the beginning of the new monitoring period were determined to be invalid when it was discovered that the wrong meter was used to measure TDS. After this occurrence, all compliance TDS samples were submitted for certified analysis by EPA-approved method 160.1. In addition, LLNL staff began using a calibrated TDS meter for maintenance measurements.

Discharges from Categorical Pretreatment Processes

Self-monitoring wastewater pretreatment programs are required at both the Livermore site and Site 300 by the LWRP serving under the authority of San Francisco Bay RWQCB. The LWRP has identified specific LLNL wastewater generating processes that fall under the definition regulation of two categorical standards: electrical and electronic components and metal finishing. The sampling and monitoring from nondomestic, industrial sources covered by pretreatment standards defined in 40 CFR 403 is required in the 1994–1995 Waste Discharge Permit No. 1250 issued for the discharge of wastewater from LLNL into the City of Livermore sewer system.

The general pretreatment regulations establish both general and specific prohibited discharge standards (40 CFR 403.5) that apply to all industrial users. Categorical standards are published by the EPA as separate regulations and contain numerical limits for the discharge of pollutants from specified industrial categories. However, because LLNL has been, and is continuing to pursue an exemption from the categorical standards with the EPA, components of the standards have not been followed as in past years. This is being done with the understanding and concurrence of both the LWRP and the Pretreatment Coordinator, EPA Region 9.

This year LLNL has maintained strict compliance with all applicable categorical standard discharge limits that apply to industrial processes discharging to the sanitary sewer. However, we have not formally adhered to the monitoring and reporting requirements stated in Discharge Permit 1250 (1994–1995) or 40 CFR 433 or 469. Quarterly and semiannual sampling did not take place, nor were semiannual wastewater reports submitted to the LWRP. Similarly LWRP has suspended its inspection schedule of the regulated processes at LLNL. LLNL has formally notified both the LWRP and the EPA that regulatory documentation will not be provided pending the final outcome of this exemption request. LLNL wastewater representatives are working closely with LWRP and the EPA personnel to reach a decision in this matter. When a decision has been reached on the future level of compliance LLNL must follow regarding the categorical standards, LLNL will continue to maintain strict adherence to the applicable requirements.

Although the list of LLNL wastewater-generating processes that meet the definition of a Categorical Discharger (as set forth in the Industrial Categories 40 CFR 405 through 471) changes throughout the year (as a function of research and development needs fluctuating, e.g., CRADA's with a finite life span), we have maintained compliance with the applicable discharge limits for those processes identified in Discharge Permit No. 1250 (1994–1995) and discharge to the sanitary sewer. **Tables 13-12** and **13-13** provide LLNL's internal discharge limits for these wastewaters. Those processes that discharge to the sanitary sewer are subject to the pretreatment self-monitoring program specified in the Wastewater Discharge Permit issued by the LWRP. In 1994, no exceptions to the pollutant limitations of the discharge permit were observed.

Table 13-12. LLNL's internal discharge limits for nonradioactive parameters in wastewaters from noncategorical and categorical processes, mg/L.

Parameter	Noncategorical[b]	Discharge Limits[a]	
		Metal Finishing	Electronic Components
Metals			
Beryllium	0.74		
Cadmium	0.9	0.26	
Chromium (total)	4.9	1.0	
Copper	10	2.07	
Cyanide[c]	5	0.65	
Lead	4.9	0.43	
Mercury	0.05		
Nickel	5	2.38	
Silver	1	0.24	
Zinc	15	1.48	
Organics			
Total toxic organics	4.57	2.13	1.37
Physical			
pH (units)	5–10	5–10	5–10
Other			
Oil and grease	500		
Total dissolved solids	375 above background		

a These standards are specified by the EPA. By regulation, the EPA or City of Livermore limit is used, whichever is lower. Noncategorical limits apply where no standard is specified.

b These standards have been established to meet the City of Livermore's requirements at the Building 196 outfall.

c Limits apply to CN discharges other than CN salts. CN salts are classified by the State of California as "extremely hazardous waste" and cannot be discharged to the sewer.

Table 13-13. LLNL's internal discharge limits for radioisotopes in wastewaters.

Parameter	Individual Discharges		Total Daily Limit for Site	
Gross alpha	11.1 Bq/L	(0.3 µCi/1000 L)	185 kBq	(5.0 µCi)
Gross beta	111 Bq/L	(3.0 µCi/1000 L)	1.85 MBq	(50.0 µCi)
Tritium	185 kBq/L	(5.0 mCi/1000 L)	3.7 GBq	(100.0 mCi)
Gamma		—[a]		—[a]

[a] There is no gross gamma limit; isotope-specific limits apply.

Site 300 Ground Water Compliance Monitoring

Ground water compliance monitoring programs are carried out at Site 300 in response to LLNL Site 300 Resource Conservation and Recovery Act (RCRA) Closure and Post-Closure Plans for Landfill Pits 1 and 7 and WDR Order Nos. 93-100 and 85-188. Compliance monitoring and reporting allow LLNL to evaluate operations of RCRA Landfill Pits 1 and 7 and the High Explosive (HE) Process Area Class II surface impoundments and assure they are consistent with regulatory requirements. WDR Order No. 85-188 establishes the basis for compliance monitoring for HE Process Area Class II Surface Impoundments. WDR Order No. 93-100 and the post-closure monitoring plan developed within the RCRA Closure and Post-Closure Plans established the basis for the compliance monitoring network around Pits 1 and 7. Data presentation and evaluation for these compliance networks are presented in Chapter 7. These monitoring programs include quarterly monitoring of the ground water wells in each monitoring network and quarterly and annual self-monitoring reporting.

Monitoring Reporting Program No. 93-100 for the Pits 1 and 7 network includes sampling and analysis of ground water monitoring wells for parameters listed in **Table 13-14** and establishes concentration limits at the point of compliance. The post-closure monitoring plan requires sampling and analysis of ground water from wells for following the parameters:

- Pit 1—Arsenic, cadmium, chloride, chromium, iron, phenols, manganese, mercury, nickel, nitrate, selenium, silver, sodium, sulfate, conductivity, pH, TOC, TOX, barium, beryllium, lead, VOCs using EPA Method 601/624, semivolatile organic compounds using EPA Method 625, gross alpha, gross beta, tritium, HMX, RDX, and TNT.
- Pit 7—Antimony, VOCs using 601/624, gross alpha, gross beta, and tritium.

Ground Water Monitoring Program No. 85-188 does not establish concentration limits at the point of compliance but requires quarterly sampling for the following parameters and constituents: total organic halogens (TOX), total organic carbon (TOC), pH, electrical conductivity, nitrate, nitrite, high explosive compounds (HMX and RDX), nickel, selenium, silver, thallium, vanadium, zinc, molybdenum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, and mercury. The monitoring program also requires weekly inspection of the surface impoundments leachate collection systems for fluid accumulation and quarterly checking of lysimeters or the leachate collection systems. If water is found in the lysimeters or the leachate collection systems, the water must be analyzed for pH, electrical conductivity, HMX, and RDX.

Table 13-14. Monitoring parameters and concentration limits for landfill Pits 1 and 7 under WDR Order No. 93-100.

Constituents	Units	Concentration Limits Pit 1	Concentration Limits Pit 7
Parameters			
Depth to ground water	feet		
Total dissolved solids	mg/L		
Specific conductance	µmho/cm		
Temperature	Degrees Celsius		
pH	pH units		
Metals			
Arsenic	mg/L	0.02	TBD[a]
Barium	mg/L	0.05	0.09
Beryllium	mg/L	0.0005	0.0005
Cadmium	mg/L	0.0005	TBD
Cobalt	mg/L	TBD	TBD
Copper	mg/L	0.07	TBD
Lead	mg/L	0.009	0.009
Nickel	mg/L	0.10	TBD
Vanadium	mg/L	0.05	0.05
Zinc	mg/L	0.06	TBD
Radiologicals			
Radium 226	(pCi/L)	1.0	TBD
Tritium	(pCi/L)	500	85.7
Uranium-233,234	(pCi/L)	2.0	2.1
Uranium-235	(pCi/L)	0.2	0.1
Uranium-238	(pCi/L)	1.0	1.6
Thorium 228	(pCi/L)	TBD	TBD
Thorium 232	(pCi/L)	TBD	TBD
Explosives			
HMX	µg/L	26	TBD
RDX	µg/L	30	TBD

a TBD = Concentration limits are to be determined.